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FOR

Enhanced Email - Distributed Attachment Storage

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of data processing. More specifically, the present invention relates to methods and systems associated with email service hosting and consumption.

2. Background Information

The popularity of Internet connectivity has contributed to the fast and persistent adoption of server applications in both the enterprise and the consumer space. The features and functionalities of a particular application are no longer confined to individual machines on which the application software is installed. Instead, these features can now be made available on the Internet or on the enterprise corporate network in an ongoing service model, accessible from any machines anywhere, anytime. Also, users do not have to keep up with the nuisance of software upgrades. Since new releases only have to be installed on the central server, users can immediately benefit from the feature upgrade via the Internet, without any of the complications of installation, configuration and system compatibility check. Some of the web-based applications that have become ubiquitous by now are email management and PIMs (Personal Information Management, including calendar, contacts and tasks).

However, such a convenience comes with a toll on bandwidth and storage cost, which are the primary cost drivers of server applications:

Bandwidth cost

Since the processing power and database reside on the server, a high volume of data traffic is often created between server and client access points, and among servers themselves. To send bits from client A to client B, the supposedly straightforward data route from point A to point B now necessitates the intermediation of several servers in between, resulting in a significantly larger amount of traffic compared to a direct peer-to-peer connection.

As bandwidth is always subject to supply constraints due to its high capital cost and long lead time to deploy, ASPs and server applications have to strive hard for a way to reduce the data traffic while sustaining the same level of service to its customers.

Growth of data size

As server applications continue to upgrade their feature sets to include rich media formats (such as .JPG, .WAV and .MP3), the amount of data that needs to be transmitted and stored has grown significantly, to the point where the extra burden placed on bandwidth and storage has outpaced what can be viably offered by current-day technology. For instance, a textual email is typically only a few kilobytes in size; adding a 5-minute MP3-encoded song as an attachment can boost this size to about 5 megabytes, an increase of more than three orders of magnitude; video attachments add one more order of magnitude in size.

Storage requirements

Storing copies of files for all subscribers on the server adds up to a hefty cost. In addition to directing and temporarily storing email before it reaches its final

destination, some servers are also configured to keep backup copies of all email. For instance, the IMAP4 protocol keeps a copy of all received mail messages and attachments on the server unless instructed by the user to delete.

Such concentration of server storage model brings forth two problems:

First, there is a redundancy of storage beyond needs. For example, once an email is sent, the sender keeps the original copy of any attachments on his personal computer; the attachments also reside in the sent mail folder on his server. On the reception side, the receiver keeps a backup copy of the email and attachments on his mail server (which could be a operated by a different provider), and also downloads these to his desktop machine. Thus an attachment file meant for two parties now becomes populated on servers on both ends, exerting unnecessary burden on the storage needs of the intermediating servers. To wit, most web-based email services are currently only able to provide enough space to store *one* MP3-encoded song attachment per user mailbox; due to these size restrictions, users of these services cannot send video clips as email attachments at all

Second, multiple copies of the same document residing on both servers and client machines tend to cause confusion when changes are made. Data integrity has always been a difficult problem to tackle, especially in a world that promotes ubiquitous access to the same data. For example, when the receiver of an attachment makes certain changes and sends them back to the author via a web-based email system, the sender needs to upload the document again, no matter how small the change is; this cycles the new version of the document through the same storage duplication as the incoming route. Not only does this approach make it hard to keep track of changing data, but it also contributes to redundant storage of the same file over and over again, although each copy may be only marginally different from each other.

In order to save bandwidth and server space for data that cannot be handled otherwise, a huge opportunity exists to leverage the under-utilized storage space, processing power, and network bandwidth of the user machines themselves. This opportunity is based on a distributed computing model to assist certain server functions, and to allow server intermediation to be forgone as appropriate. Redundant storage of the same document can be minimized. This not only saves bandwidth and disk storage costs for the operators, but also enhances the performance of data transfer, and makes it easier to keep data distributed and synchronized at a much faster speed.

SUMMARY OF THE INVENTION

A sender email client, in response to a request to send an email with attachment, determines whether a recipient of the email has distributed storage separate from an incoming email server of the recipient for storing email attachments. If so, a location server is consulted for the distributed storage's network address and its availability is determined. The send request is then serviced accordingly.

A location server, in response to a request to register a user's email attachment distributed storage, registers the distributed storage's network address. The location server provides a requestor with the registrant's distributed storage's network address, when requested.

An email service, in response to receiving an email with attachment, determines whether a recipient of the email has distributed storage for storing email

attachments. If so, its network address and availability are likewise determined. The attachments are forwarded to the recipient's distributed storage for storage, when it becomes available.

An email recipient client, in response to a request to access an email attachment, retrieves the attachment from the recipient's distributed storage or the incoming email server, as appropriate.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

Figure 1 illustrates a network view of the present invention in accordance with one embodiment;

Figure 2 illustrates a sender and recipient method view of the present invention, in accordance with one embodiment;

Figure 3 illustrates an example data structure suitable for use by a location server of **Fig. 1** to practice the present invention, in accordance with one embodiment;

Figures 4a-4b illustrate the operational flow of the relevant aspects of a location server of **Fig 1**, in accordance with one embodiment;

Figure 5 illustrates the operational flow of the relevant aspects of the enhanced email program/service of **Fig 1**, in accordance with one embodiment; and

Figure 6 illustrates an example computer system suitable for use to practice the present invention, in accordance with one embodiment.

DETAILED DESCRIPTION OF THE INVENTION

As summarized earlier, the present invention includes improved methods and related apparatuses for hosted email services. In the description to follow, various aspects of the present invention will be described. However, the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, the present invention may be practiced without some of the specific details. In other instances, well known features are omitted or simplified in order not to obscure the present invention.

Parts of the description will be presented in terms of operations performed by a processor based device, using terms such as data, tables, requesting, determining sending, and the like, consistent with the manner commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. As well understood by those skilled in the art, the quantities take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and otherwise manipulated through mechanical, electrical, or optical components of the processor based device. The term "processor" includes microprocessors, micro-controllers, digital signal processors, and the like, that are standalone, adjunct or embedded.

Various operations will be described as multiple discrete steps in turn, in a manner that is most helpful in understanding the present invention. However, the order of description should not be construed as to imply that these operations are

necessarily order dependent. In particular, these operations need not be performed in the order of presentation. Further, the description repeatedly uses the phrase "in one embodiment", which ordinarily does not refer to the same embodiment, although it may.

Overview

Referring now first to **Figure 1**, wherein a block diagram illustrating a network view of the present invention, in accordance with one embodiment, is shown. As illustrated, email sender **102** and email recipient **112**, more specifically, their respective computing devices **103** and **113** are coupled to each other, via networking fabric **120**. Each of computing devices **103** and **113** is equipped with a email client, client **104** and **114** respectively. Clients **104** and **114** are both incorporated with the teachings of the present invention, to be described more fully below. For ease of understanding, both email clients **104** and **114** are client programs or agents of hosted email service **122**. However, from the description to follow, those skilled in the art will appreciate that each of email clients **104** and **114** may be a client program/agent of different hosted email service or email servers. Those skilled in the art will furthermore appreciate that in one embodiment, client **104** could be also part of an agent or hosted email service. In this embodiment, client **104** could be the outgoing (or "send") path of an existing email agent or hosted email service (for instance, in one embodiment, client **104** could be an enhanced Microsoft Exchange server).

Host email service **122** is also incorporated with the teachings of the present invention, also to be described more fully below. Hosted email service **122**, more specifically, the server or servers hosting email service **122** (including the incoming

and outgoing email servers), are coupled to computing devices **103** and **113** through networking fabric **120**.

Additionally, in accordance with the present invention, recipient **112** is also endowed with distributed storage **116** for storing email attachments for recipient **112**. Further, present in the networking environment is distributed storage location service **124** for providing requestors with network addresses of and availability information for distributed storages **116** of registered recipient users. As with earlier enumerated elements, distributed storage **116** and distributed storage location service **124** (more specifically, its server or servers) are coupled to each other and the earlier enumerated elements via networking fabric **120**.

In accordance with the present invention, when sender **102**, via its email client **104**, sends an email with attachment, to recipient **112**, while the main body of the email is sent to the incoming email server of recipient **112**, i.e. email service **122**, as in the prior art, the email attachment, on the other hand, is advantageously sent to distributed storage **116** for storage instead, except when distributed storage **116** is unavailable. As a result, email service **122** is relieved of the responsibility or burden of storing email attachments for recipient **112** (as well as other likewise endowed recipient service subscribers). As those skilled in the art will appreciate that the resulting storage savings to email service **122** could be substantial, especially when email service **122** services a large number (for instance, hundreds of thousands) of service subscribers, or is frequently used to send very large attachments.

Computing devices **103** and **113** may be any one of a broad range of computing devices known in the art, including but are not limited to, palm sized personal digital assistants, notebook sized computers, desktop computers, set top boxes and so forth. Similarly, any one of a number of servers known in the art may

be employed to host email service **122**, and distributed storage location server **124**. Likewise, any one of a number of network addressable storage devices, computers or devices of like type may be employed to practice the distributed storage aspect of the present invention.

Networking fabrics **120** may be private and/or public network or networks inter-networked together. In one embodiment, networking fabric **120** is the Internet. Communication links **105**, **115**, **123**, **125** and **127** coupling computing devices **103**, **113**, email server **122**, location server **124** and distributed storage **116** to networking fabrics **120** respectively may be any one of a number of wireless or wired communication links known in the art, including but not limited to, Ethernet connections, modem connections, Integrated Service Digital Network (ISDN) connections, Digital Subscriber Line (DSL) connections, Cable connections, Asynchronous Transfer Mode (ATM) connections, Frame Relay connections and so forth.

Communications between computing devices **103**, **113**, servers of email service **122**, location service **124**, and distributed storage **116** may be conducted using any one of a number of message and communication protocols known in the art. In one embodiment, the communications are achieved via Hypertext Transmission Protocol (HTTP) connections, with the packets being sent and received in accordance with the Transmission Control Protocol/Internet Protocol (TCP/IP).

Similarly, except for the teachings of the present invention incorporated therein, email service **122** and email clients **104** and **114** may be any one of a number email server/client pairs known in the art. In the afore mentioned embodiment, email service **122** is a web based service, and email clients **104** and

144 are web pages and associated applets or objects executing in a generic agent, such as a web browser.

Further, while for ease of understanding, only one email sender **102** and one email recipient **112** are shown, from the description to follow, those skilled in the art would appreciate that the present invention may be practiced with numerous email senders and recipients. In fact, the present invention may be practiced in co-existence with the prior art, i.e. not all senders and/or recipients, nor email services have to be enhanced with teachings of the present invention. Those who have been will enjoy the benefits of the present invention. Otherwise, the senders and recipients, with or without the present invention co-exist together.

Sender and Recipient

Having now generally described the context for practicing the present invention, we turn now to describe the present invention in further details from the sender and the recipient's perspective. Referring now to **Figure 2**, wherein a block diagram illustrating the present invention from the sender and the recipient's method view is shown. As illustrated, the method starts with email sender **102** using email client **104** to compose and send an email message to recipient **103**, block **202**. In response to a request to send the email, email client **104** checks to determine whether the email to be sent has attachments, block **204**.

If it is determined that the email to be sent has any attachments, email client **104** further proceeds to determine whether a specified recipient is endowed with a distributed storage (**116** of **Fig. 1**) for storing email attachments in accordance with the present invention, and if so, its network address, block **206**. For the illustrated embodiment, this information is obtained by advantageously using the distributed storage location server **124**. If it is determined that the specified recipient being

process is endowed with such distributed storage, email client **104** further determines if the distributed storage is currently accessible, block **208**.

Email client **104** then services the send request based on the results of these determinations, block **210**. More specifically, for the illustrated embodiment, if it is determined that the specified recipient being processed is endowed with such distributed storage, and the distributed storage is currently accessible, email client **104** sends the main body of the email to the incoming email server of the specified recipient, and causes the attachment or attachments to be sent to distributed storage of the specified recipient for storage. On the other hand, if it is determined that either the recipient is not endowed with such distributed storage, or it is endowed, but its distributed storage is currently inaccessible (e.g. currently not online), email client **104** sends both the main body as well as any attachment to the incoming email server of the specified recipient being processed.

For the illustrated embodiment, email client **104** determines whether a specified recipient being processed is endowed with such distributed storage (including its network address) by querying a distributed storage location server (such as distributed storage location server **124** of **Fig. 1**). In one embodiment, if the specified recipient is endowed with such distributed storage, location server **124** returns the network address automatically; otherwise location server **124** returns a null value (or alternatively, an error code). In another embodiment, location server **124** additionally returns an attribute bit denoting whether the recipient's distributed storage is currently available.

In one embodiment, email client **104** determines the current availability of the distributed storage by pinging the distributed storage. In one embodiment, the affirmative verification is made regardless of the qualifying attribute information

returned from location server **124**. In another embodiment, email client **104** relies on the availability information returned by location server **124**.

In one embodiment, upon determining a recipient is endowed with such distributed storage, and the distributed storage is currently accessible, email client **104** "sends" the attachment or attachments to the recipient by sending an instruction to the distributed storage to "pull" the attachment or attachments. In response, the distributed storage "pulls" accordingly. In one embodiment, the recipient is an agent or hosted email service; in this embodiment, the agent or hosted service implements the necessary features (or a logical recipient) to support the above steps.

In one embodiment, when more than one recipient is specified for an email with attachment, blocks **206-210** are repeated for each specified recipient. In one embodiment, a recipient may be explicitly specified or implicitly specified by way of a group address. In one embodiment, email client **104** accesses address books of sender **102** to determine if any specified addressee is a group addressee and resolves the individual recipients based on the content of the address books.

Continuing to refer to **Fig. 2**, over at the recipient side, eventually, recipient **112** uses email client **114** to open a received email to view the email, block **212**. Assuming the email has one or more attachments, eventually, recipient **112** opens or otherwise accesses the attachment (e.g. to save or otherwise extract the attachment from received email), block **214**. In response, email client **114** first accesses its distributed storage to attempt to retrieve the attachment. If the attempt is unsuccessful, i.e. the attachment of interest is not in the distributed storage (this corresponds to the case where the attachment could not be deposited into distributed storage by email client **104**), email client **114** retrieves the attachment from its incoming email server.

Recall from the earlier description that the attachment or attachments are nevertheless sent to the recipient's incoming email server if the recipient's distributed storage is unavailable (even though recipient has been so endowed), or if the recipient has not been endowed with the teachings of the present invention. Further note that none of these operations will be performed, and email services will progress as in the prior art, if one or both the sender and the recipient are not enhanced with the teachings of the present invention. Operation of the incoming email server will be described in further detail below.

Location Server

Referring now to **Figure 3**, wherein a data structure suitable for use by distributed storage location server **124** to practice the location server aspect of the present invention, in accordance with one embodiment, is shown. Shown is a table/view **300** having network addresses **304** of the distributed storages of the registered subscribers **302** of location server **124**. In alternate embodiments, other data organizations may be employed. In alternate embodiments, table **300** also stores the current availability of distributed storage **306**.

Figures 4a-4b illustrate the operational flow of the relevant aspects of location server **124**, in accordance with one embodiment. As illustrated in **Fig. 4a**, in response to a registration request of a new service subscriber, block **402**, location server **404** registers the subscriber user, and stores the network address of the subscriber user's distributed storage for storing email attachments. In one embodiment, the network address of the distributed storage of the subscriber user is provided to location server **124** as part of the registration process, if the distributed storage has a statically assigned network address. In one embodiment, location server **124** also supports dynamic provision of the network address, when the

distributed storage is dynamically assigned its network address when it comes online. In a preferred implementation of this embodiment, support is also provided to the distributed storage to notify location server **124** when the distributed storage goes offline (thereby allowing location server **124** to remove the temporal dynamic network address from its storage). In an alternate embodiment, distributed storage will be considered unavailable and marked as such in table **300** column **306** if it hasn't "pinged" location server **124** for a specified time.

As illustrated in **Fig. 4b**, in response to a request for a recipient's distributed storage's network address, block **412**, as described earlier, location server **124** returns the network address, or a null value/error code, as the case may be. Recall from earlier description, the request for the network address may be implicit, and automatic. That is, the network address may be automatically returned in response to an inquiry on whether a recipient is endowed with a distributed storage for storing email attachments. The request/response operation may be performed in accordance with any predetermined protocols.

Email Service - Incoming Email Server

Referring now to **Figure 5**, wherein a block diagram illustrating the operation flow of the relevant aspects of email service **122** (more specifically, the incoming email server of recipient), in accordance with one embodiment, is described. As illustrated, in response to the receipt of an email with attachment or attachments from a sender, on behalf of a recipient, block **502**, email service **122** determines whether the recipient is endowed with distributed storage for storing email attachments, block **504**. Email service **122** also determines the network address of the distributed storage, block **506**. As described earlier, email service **122** may nevertheless receive email attachments on behalf of a recipient, notwithstanding the

recipient has been endowed with distributed storage for storing email attachments. The reason being, the endowed distributed storage may be unavailable at time email sender sends the email with attachment, or the email is sent by a client that has not been endowed with the teachings of the present invention. In one embodiment, the two operations, i.e. determining whether a recipient is endowed with the distributed storage, and the network address of the distributed address, are integrally performed.

Similar to the manner sender email client **104** operates, upon determining the network address of the distributed storage of a recipient, email service **122** periodically checks for the availability of the recipient's distributed storage to determine whether the distributed storage becomes available (e.g. coming back online). Once it is determined that the distributed storage of interest is available, email service **122** automatically transfers the received attachment or attachments to the recipient's distributed storage for storage.

Note that while it is preferred that email service **122** is also enhanced to be able to offload this storage burden once the distributed storages of the recipients come back online, the present invention may nevertheless be practiced without email service **122** being enhanced. In these embodiments, the benefits of the present invention will only be realized in those situations where the recipient's distributed storages are online at the time the senders send the attachments or at the time the receiving service receives the attachments.

Example Computer System

Figure 6 illustrates an exemplary computer system **600** suitable for use as either a sender/recipient computer **103/113** or a hosting server of email service **124** of **Fig. 1**, in accordance with one embodiment. As shown, computer system **600**

includes one or more processors **602** and system memory **604**. Additionally, computer system **600** includes one or more mass storage devices **606** (such as diskette, hard drive, CDROM and so forth), one or more input/output devices **608** (such as keyboard, cursor control and so forth) and communication interfaces **610** (such as network interface cards, modems and so forth). The elements are coupled to each other via system bus **612**, which represents one or more buses. In the case of multiple buses, they are bridged by one or more bus bridges (not shown). Each of these elements performs its conventional functions known in the art. In particular, system memory **604** and mass storage **606** are employed to store a working copy and a permanent copy of the programming instructions implementing the teachings of the present invention. The permanent copy of the programming instructions may be loaded into mass storage **606** in the factory, or in the field, as described earlier, through a distribution medium (not shown) or through communication interface **610** (from a distribution server (not shown). The constitution of these elements **602-612** are known, and accordingly will not be further described.

While example computer system **600** has been described as being suitable for use as computing device **103/113** or a hosting server of email service **122**, those skilled in the art will also appreciate that example computer system **600** may also be used to practice the location server aspect of the present invention, or the distributed storage itself.

Modifications and Alterations

While the present invention has been described referencing the illustrated and above enumerated embodiments, the present invention is not limited to these described embodiments. Numerous modification and alterations may be made, consistent with the scope of the present invention as set forth in the claims to follow.

For example, while distributed storage **115**, for ease of understanding, has been described as separate and distinct from the recipient's computing device **113**, the present invention may also be practiced with the recipient's computing device **113** and distributed storage **115** being the same device. Similarly, while for ease of understanding, location server **124** has also been described as separate and distinct from the hosting server of email service **122**, the present invention may also be practiced with email service **122** also providing for location service **124**. Further, while the recipient's distributed storage being offline has been described as a responsibility of email service **122** to address, the present invention may also be modified and practiced with the responsibility being that of the sender's email client (**104** of **Fig. 1**). Similarly, while email client **104** has been described as a client program or agent of hosted email service **122**, the present invention may be practiced with email client 104 being part of the same email service **122** or of a different email service. Of course, the above examples are merely illustrative. Based on the above descriptions, many other equivalent variations will be appreciated by those skilled in the art.

Conclusion and Epilogue

Thus, a method and apparatus for an enhanced email service with less bandwidth and storage burden to the email service, in particular, web based email service, has been described. Since as illustrated earlier, the present invention may be practiced with modification and alteration within the spirit and scope of the appended claims, the description is to be regarded as illustrative, instead of being restrictive on the present invention.
